

# NATURAL DISASTERS AND THE IMPORTANCE OF GEOSPATIAL AWARENESS AND TECHNOLOGIES

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*Image courtesy of USGS.*

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**W**hen natural disaster strikes, few things are as important as one's sense of place and location. Immediate concerns during these events include: Who was in the path of the tornado or flood? Are any roads or highways closed? Where are shelters open for displaced residents? What does my home or business look like now? The intersection of population and infrastructure with the footprint of harm's way is critical to understanding what happened, who is impacted and what the path to recovery may look like.

Once response efforts get underway, the specifics of the impact become more challenging. How many specific properties were impacted and to what extent? How has the environment changed? Is the local infrastructure compromised, such as the soil and bedrock around bridges and pipelines? Will recovery efforts be hampered by current conditions?

And as days turn into weeks, the affected region attempts to get back to business as usual. Assessments are needed to allocate resources; physical progress must be tracked and managed. There are administrative concerns as well: The Federal Emergency Management Agency (FEMA) requires specific processes and documentation for reimbursement, property taxes may have to be re-assessed and reduced, and insurance claims need to be verified.

Thankfully, the combination of data and geospatial technologies can tell us a great deal about what happened and how to quickly and efficiently begin recovery efforts. Many federal agencies, such as the National Oceanic and Atmospheric Administration (NOAA) and the National Weather Service (NWS), have provided publicly accessible geospatial datasets to support disaster recovery for years. And this trend is

increasing as the use of geospatial data by smaller city and county entities becomes more prevalent and easily integrated at the local level.

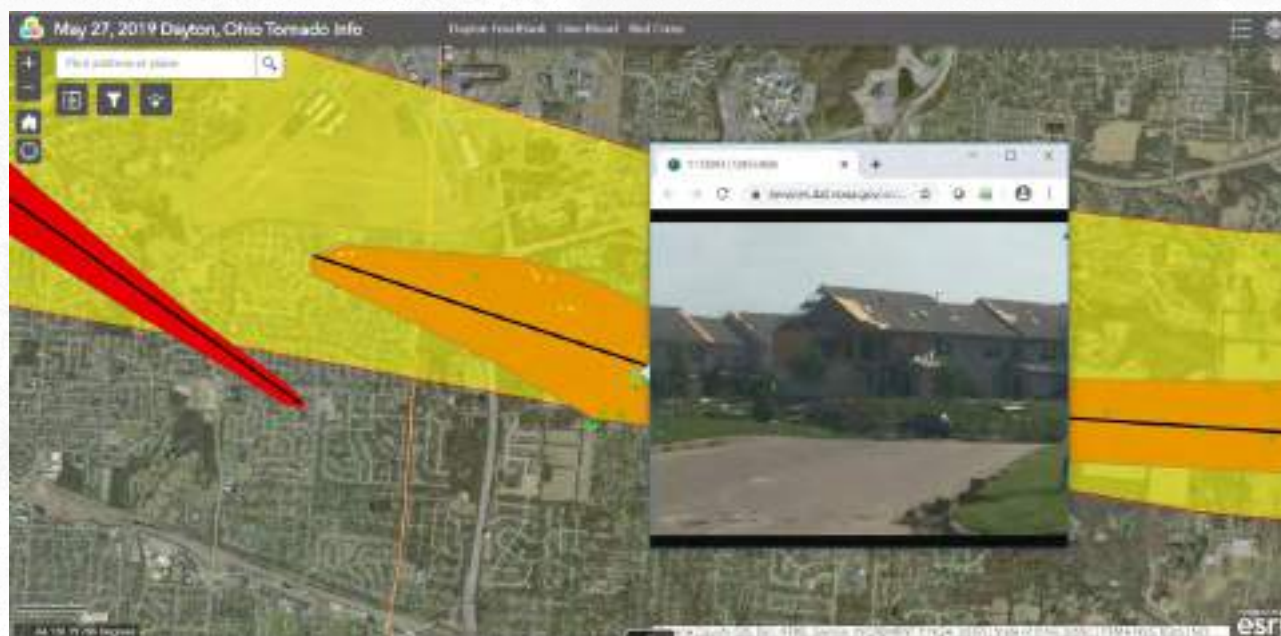
This provision of geospatial data at multiple scales will continue to enhance disaster recovery efforts by giving responders and those impacted an understanding that spans large scale planning of resources at the county level as well as specific remediation tasks needed at a property or structure. Recent examples are highlighted below.

## In the Path of Tornadoes

Woolpert has provided emergency response in the wake of natural disasters for nearly 100 years. The earliest aerial imagery project in the firm's archive is of the flood of 1937 in Cincinnati. In more recent years, Woolpert has been utilizing geospatial technologies to help local, state and federal officials quickly assess damages. One of those devastating events touched close to home for Woolpert, an international architecture, engineering and geospatial firm that has been headquartered in Dayton, Ohio, since 1911.

A record-breaking 15 tornadoes roared through southwest Ohio late at night on Memorial Day 2019. Powerful EF4 and EF3 tornadoes tore paths through the Dayton area just a few miles from the Woolpert office and impacted multiple employees' homes. Two deaths and dozens of injuries were attributed to the storms, which destroyed and damaged thousands of homes, businesses, public parks and facilities.

Within 24 hours of the storms, Woolpert made available to the public an interactive map showing the paths of the tornadoes by incorporating geospatial imagery with available data



Woolpert created an interactive map showing the path of the tornadoes that blew through Dayton, Ohio, in 2019, incorporating data from NOAA and NWS. Image courtesy of Woolpert.



Imagery collected before and after the Dayton tornadoes provided useful information for assessing pre-and post-disaster conditions. These oblique images show Hara Arena, a 5,500-seat multipurpose venue located in Dayton, before and after tornado damage. Images courtesy of Lexur Associates.

from NOAA and NWS. The map was posted on the company's website and shared publicly through social media. The map illustrated where the storms likely caused the most destruction. Users could interact with the map to add or take away layers of data, which included what schools, churches and other facilities were being used as shelters. The application also integrated field-collected datapoints detailing exact damage locations beside images of affected structures and debris found.

Coincidentally in March, prior to the tornado outbreaks, aerial imagery had been collected by Woolpert in Montgomery County, where Dayton is located. While the original intent of this imagery was to support property valuations, these datasets proved useful for assessing pre- and post-disaster conditions. Updated images were acquired in June, enabling all involved to clearly understand and validate field and infrastructure conditions.

Montgomery County Auditor Karl Keith told news reporters at the time that the before-and-after images were used to help determine which properties had reduced values as a result of the damages and thus were entitled to tax reductions.

The devastation has led to ongoing recovery efforts in communities where residents and business owners continue to rebuild, and local government officials secure grant funding to replace damaged infrastructure. Even though over a year has passed since this incident, many area residents are still heavily involved in the rebuilding process.

The approach used in this response allowed first responders to review large areas, assess specific tornado paths and tracks, and then zero-in on precise damage locations—all from the safety of local offices.

## Before and After the Floods

Hurricanes Harvey and Irma flooded communities along the southern coast of the U.S. in August-September 2017. And historic flooding occurred in South Carolina in 2015 as a result of record rainfall. In each of these incidents, manned aircraft were used to collect high-resolution, before-and-after aerial imagery, which was then processed to show the devastation from the storms. The acquired aerial imagery was used to produce interactive maps featuring a slider that enabled users to navigate and zoom-in on specific locations to see what their communities looked like before and after rising tides inundated coasts and torrential downpours sent rivers overflowing.



This image taken from the Woolpert website after Hurricane Harvey hit Houston, Texas, helped illustrate before and after ground conditions and document damages to identify where resources were most needed. Image courtesy of Woolpert.



Aerial imagery collected by Woolpert as the waters crested following the 1,000-year flood that hit South Carolina in 2015 showed devastation from the storm. The imagery was shared with multiple state agencies and local governments within 24 hours to help them respond to road and dam failures and provide guidance on how to prioritize recovery efforts. Image courtesy of Woolpert.

In the days following each of those disasters, thousands of miles of aerial imagery were collected, processed and delivered in meaningful ways. The imagery helped local, state and federal officials assess and document damages, determine current flood conditions and establish where resources were needed most. The maps also gave members of the public the ability to check on specific neighborhoods and get a firsthand look at the extent of damages to their homes and businesses.

As detailed in the above scenarios, data collected immediately following a disaster can be incorporated into change-analysis products and delivered within 24 hours. Interactive maps with layers of information can be created from the geospatial imagery and shared publicly for access to anyone affected by the event. Photos of devastated areas taken before and after storms can be incorporated into interactive programs that give users a unique and valuable perspective. Such digital content is invaluable to the public and can provide local government officials, first responders, legislators and members of the public firsthand knowledge of what's happening in often hazardous environments.

## COVID-19 and Disaster Recovery

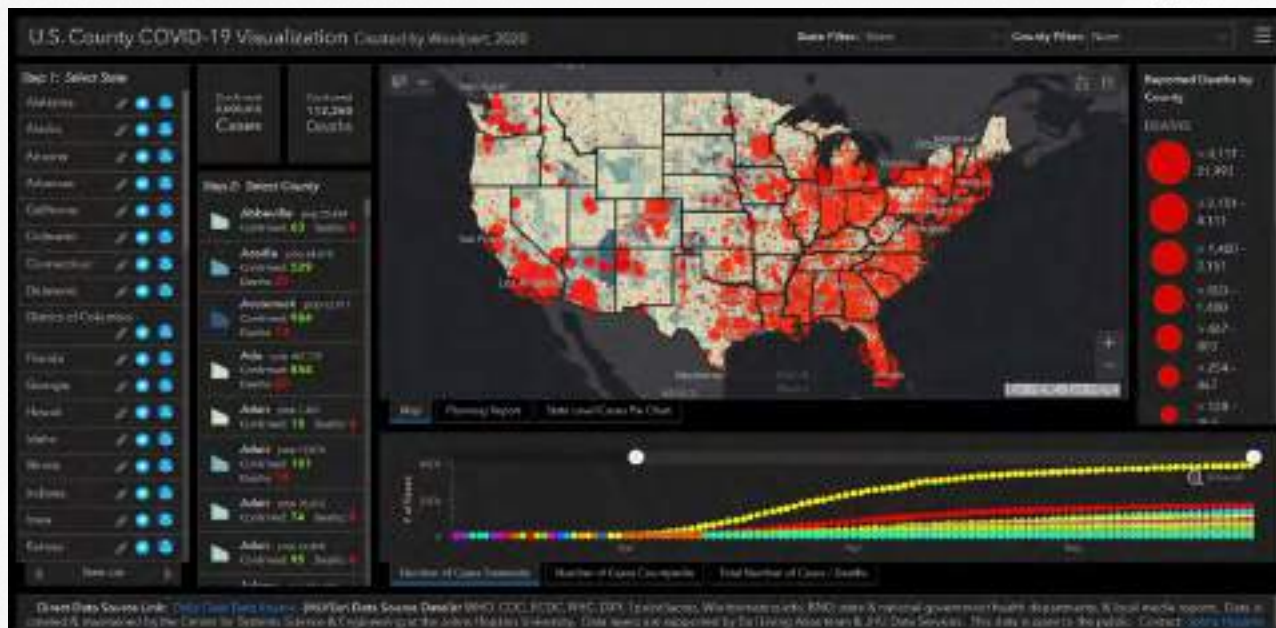
2020 has presented disaster recovery concerns of an unprecedented nature. The COVID-19 pandemic has created an invisible threat, common to all countries, that appears to be controlled by precise human proximity. COVID-19 presents a footprint that is global in scale, yet extremely local in spread. While there are many unknowns, the prevailing message is to keep social distance as much as possible. The underlying geospatial complications are staggering; to keep the population of the planet six feet apart at all times is a spatial awareness problem of epic proportions. And while the current challenges

are unique, the geospatial community remains committed to supporting COVID-19 disaster response by focusing on understanding available data and responder workflows.

Confirmed COVID-19 cases, death rates and other related metrics are publicly available. The integration of these data sources with location information provide visualizations of current spread, potential paths, and overarching patterns to better understand and plan for virus response. Woolpert created a county-by-county United States dashboard of case and death data over time and by location. By aggregating data geospatially, responders can review comprehensive virus status alongside population densities, multi-tenant facilities and other important metrics. Geospatial visualizations will become more important as various jurisdictions adjust and refine operational and social distancing policies along invisible administrative boundaries. Geospatial analysis of policy changes based on political boundaries may shed light on best practices for future response efforts.

And while virus tracking and monitoring will continue to provide benefit for approaches like contact tracing and Indoor Positioning Systems (IPS), the geospatial community can also support disaster response by assisting with known workflows. In events like COVID-19, response efforts are often chaotic as initial information is compiled, and those affected struggle to reprioritize processes, staff and funding. Rapid ramp-ups can be challenging, but government agencies must follow specific guidelines to be eligible for FEMA disaster reimbursement funding.

In these instances, geospatial technology is being used to provide first responders and operators with reimbursement specific field data collection tools. Woolpert is working directly with Esri to provide end-users with mobile tools to track



Woolpert created a county-by-county United States dashboard of COVID-19 case and death data over time and by location. By aggregating data geospatially, responders are able to review comprehensive virus status alongside population densities, political boundaries, and other important demographic metrics. Image courtesy of Woolpert.

virus response efforts in real time, on a map and to specific FEMA reimbursement standards. These process-oriented support tasks help responders focus on the tasks at hand, and the remove the guesswork on what needs to be collected and the required level of detail.

Geospatial data and technologies are invaluable tools in response to natural disasters. Benefits are being discovered every day as public and private institutions rely increasingly on geospatial approaches: aerial imagery from manned and unmanned aircraft, publicly available data feeds, process-driven response workflows and spatially aware datasets. And while proven geospatial data and approaches will continue to refine the response to recurring natural disasters—tornadoes,

floods, wildfires, etc.—the industry is just beginning to define ways to address the unique challenges of COVID-19.

As we work to understand the how and why of COVID-19, the where or location of people, assets, resources and virus data will certainly be central to our success in identifying, containing and ultimately stopping the spread of this natural disaster.

## Author

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